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infant mortality of to-day is largely, if not entirely, due to present ignorance of various laws of life. As many women naturally have large families it follows that there is plenty of room for women with intellectual pursuits, but the home must remain the keystone of society.

In closing we desire to draw attention to the vastness of the field of sex as a subject of investigation and the undoubted importance of the results of investigations in this line, not only in their bearing upon scientific and philosophical questions, but more especially as such results affect the general happiness and progress of the race. All other reforms really wait for sexual reform to lay the foundations. This reform has begun to take active shape in the world's work in such organizations as the White Cross League; and the old forces of prudery are beginning to weaken. There must however be more open and free delivery of facts before investigators in the field can make much progress. The laws of Natural Selection will vindicate the right by the constant destruction of lines of degeneracy as well as conditions of stagnant conservatism. One fact comes out clearly and that is that biology is the beginning of psychology, sociology and kindred sciences.

Appendix: While no attempt has been made to include all important papers bearing on these subjects, but rather to give a brief hearing to a few or sometimes a single work in each line, it was my intention to note Galton's work in heredity more carefully than was done in the first section. This author appears to me to have been led into a fallacy in considering that as we have two parents, four grand-parents, eight great grand-parents, etc., it follows that our distant ancestors are each represented by an infinitesimal factor in us. Our thesis is that the whole of each of all our ancestors is present in each of us, but that which is truly individual, i. e. our contribution to the continuous training of the generations of gemmules from Adam down, is infinitesimal. Consequently each of our parents passed over to us Adam's body (hereditarily) plus the increments successive generations had added to this ancestral stock. Almost the whole of the body of the father is therefore identical with as large a part of the mother's body, and the two coalesce as one in the child to form the oldest and best fixed of its characters. The child starts with this species-stock, plus all the increments that have been added on the father's and on the mother's side since their gemmules, which were once associated in a single remote ancestor, parted company, at first by cell division in the ovaries, etc., and later were still further separated by the development of these cells into distinct individuals. Such is an outline of the method of organic evolution, which may be completed by the addition of a few simple specifications, such as, that the characters in ontogeny are unfolded in the order of phylogenetic differentiation and that while thus unfolding, any portion of the history may be cenogenetically revised.

The following *errata* occur in the first section: p. 98, line 14 from bottom, "became" should be "become;" p. 102, line 11, "this" should be "the above;" p. 106, line 10 from bottom, "(cytic)" should be "(cyclic)"; p. 108, line 8, "evolution is its" should be "evolutionists." The author of "*La vie psychique*," etc., is BINET. Lines 11, 9 and 8 from bottom, "experienced" should be "exercised;" "*nasulum*" should be "*nasutum*," "trichocytes" should be "trichocysts," "prendopodia"—"pseudopodia."

JULIUS NELSON.

*Ein geschlechtlich erzeugter Organismus ohne mütterliche Eigenschaften.*  
Dr. BOVERI. Gesellschaft für Morph. und Physiol. zu München.  
July 16, 1889.

Boveri brings forward a crucial experiment into the much disputed fields relating to the functions of nucleus and cell protoplasm and the parts

taken by the male and female nuclei in reproduction and heredity. The most direct way to ascertain whether the cell nucleus, the protoplasm, or both contain the elements which characterize the cell is to take the nucleus out of one cell and put it into the protoplasm of some other cell. This is what Rauber attempted to do when he interchanged the nuclei of toads' and frogs' eggs, his purpose being to see whether the protoplasm of the toad's egg would cause the product to take the form of a toad, or the nucleus of the frog's egg would shape the embryo to a frog, or whether both nucleus and protoplasm might act to produce a hybrid. Rauber's experiments failed, as might be expected in dealing with such highly specialized structures.

The year following, however (1887), the Hertwigs discovered that fragments of sea urchin ova containing no part of the nucleus might be fertilized, and they then segmented and developed like normal eggs or fragments which contained female nuclei. In order, then, to settle the question propounded by Rauber, it only remained to fertilize a denucleated fragment of the egg of one species of sea urchin with the spermatozoon of another species and keep the larva until it showed unmistakable specific characters. This is what Boveri set himself to do. The species which he found to suit his purpose are *Echinus microtuberculatus* and *Sphaerechinus granulatus*. Thus not only different species but different genera were employed, and easily recognizable characters make their appearance in the forms of the skeletal spicules by the third or fourth day, and Boveri was able to keep the larvæ for a week.

If, now, a large quantity of *Sphaerechinus* ova are shaken in a test tube with milt from *Echinus*, many of the ova will be broken and some of the fragments will contain nuclei, others not. A part of the ova remain intact and but few of these are fertilized. The nucleated and denucleated fragments, however, are fertilized in great numbers, and give rise to *dwarf larvæ of two entirely distinct types*. One class of dwarf larvæ shows an exact middle form, and since the same form, not dwarf, may be obtained from cross fertilizing intact ova, it is safe to assume that this type is developed from *nucleated* fragments. This is no more than we should expect, an intermediate form, where a cross of this kind can be effected. The interesting fact now comes to light that the other large class of dwarf larvæ *conform wholly to the male type*. This whole class must arise according to Boveri from a male nucleus developing within a *denucleated* fragment. All his attempts to demonstrate this by isolated cultures failed, but the author considers it sufficiently proved by the large numbers of male-type larvæ which made their appearance in the gross cultures, by the distinctness of the two types, and also by the interesting fact that the cell nuclei in dwarf larvæ of the male type, as shown in sections, were only about half the size of ordinary nuclei. The experiments are further confirmatory of the Hertwigs' observations and on the whole there seems little ground to doubt their validity. The experiments of Boveri, then, prove: *First*, that in this particular case, at least, the nucleus alone conveys specific characters to the offspring, and that the cell protoplasm, although essential to development, has no formative influence whatever. *i. e.*, "protoplasm is nutritive but not formative" (Weismann). *Second*, that in the above mentioned species the male and female nuclei are approximately equivalent in formative power.

The truth of the first has long been supposed, and many facts in the development of the subject point significantly toward the truth of the second proposition. The very discovery by Van Beneden (*Recherches sur la Maturation de l'Œuf et la Fécondation*. Arch. de Biol. Gand, 1883, pp. 265-640, 13 pl.), that the chromatin loops or filaments are equal in the male and female nuclei argues strongly for its validity, as

also the work of Platner (*Die Karyokinese bei den Lepidopteren als Grundlage für eine Theorie der Zelltheilung*. Internat. Monatschr. f. Anat. und Hist. III, 347-587, 2 pl., Leipzig, 1886), in showing that important steps in the perfecting for conjugation of male and female nuclei are identical. In short no difference of male and female can be discovered in the nuclear structure of male and female reproductive cells by any known method. This has led to the oft repeated statement, "chromatin is not sexed." As the writer of this section might put it: ultimately male and female protoplasms are different only in past experiences, and such differences are not observable with a microscope.

At first thought such a case of male parthenogenesis as is brought to light by Boveri's experiments seems to invalidate all theories of sex which would make the male and female factors in reproduction fundamentally different; for example, the well-known theory of Dr. Brooks that the female is in general more conservative than the male while the male tends to vary more than the female. "If a perfect animal could be developed" says this author (*Heredity*, p. 102), "from the spermatozoon of a male parent, as it can be, in cases of parthenogenesis, from the ovum of a female parent, we should have a means of proving that each sex transmits its entire organization to its offspring." "The phenomena of parthenogenesis, or reproduction by virgin females, as in the case of bees and wasps, show that the ovum alone may transmit all the established hereditary structure of the species, but there is and can be no evidence that the male element can accomplish the same thing," (p. 125). It now appears that the spermatozoon is able to do what it seemed safe enough to assert to be impossible in the nature of the case. But it must be admitted that we should not resort to the stable and ancient *echinodermata* to study variation and especially any variations which may depend upon sexual differentiations. It may well be that the male has been specialized to function as a progressive or variable factor in some species and not in others. Such an experiment as Boveri's, however, seems to preclude the universality of a principle of this kind; and still this very experiment proves more than the equivalence of the male and female element; the male nucleus being able to build up its entire structure; while the female nucleus, accepting Whitman's theory of polar globules, is able to make only a feeble effort at segmentation. This would seem to indicate a prepotency in formative power on the part of the male nucleus, which may be confined to certain species or may be a general characteristic, hitherto not so clearly revealed, but present in all male reproductive nuclei.

The work of Boveri certainly opens a new line of experiment in this interesting field. The method must be applicable to other forms, and until more experiments of the kind are made, it is useless to attempt to reason further as to the general bearings of his discovery upon questions of heredity and sex. C. F. H.

## VI.—MISCELLANEOUS.

*Die naturwissenschaftlich-psychologische Weltauffassung der Gegenwart*, von Dr. HERMANN WOLFF, Dozent an der Universität Leipzig, 1890. (2 vols.)

Whatever criticism may be made of the work before us, it is certainly large in range; and as its title indicates, represents some of the most recent phases of philosophic and scientific thought. Zeller says, that through the great development of the sciences new questions arise for solution, new means are required, and a partial change from the former experience of philosophy is possible; and so it must enter into closer relation with the sciences. The recent investigations on the organs of sense and the brain make necessary a renewed proof of the psychological and